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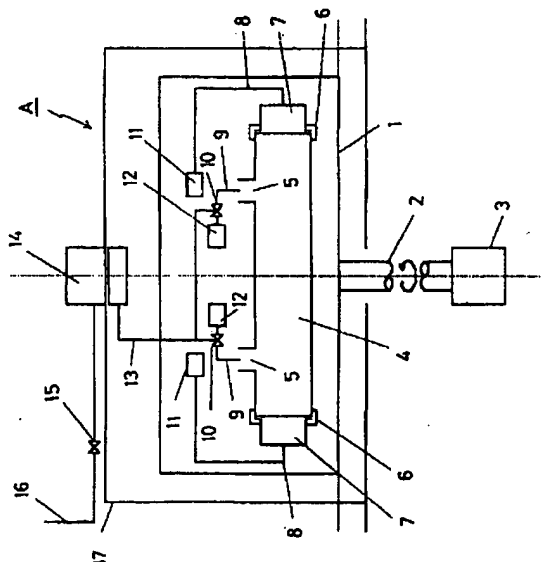
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(54) 【発明の名称】 中空糸膜モジュールの2層遠心接着装置

(57) 【要約】

【課題】 本発明は、接着剤と可撓性樹脂とにより2層遠心接着する際に遠心接着装置の回転体の回転を停止することなく接着工程を実施することにより接着時間の短縮を図ると共に、可撓性樹脂が中空糸膜束間の奥まで入り込むようにして接着界面の保護効果を高めることが出来る中空糸膜モジュールの2層遠心接着装置を提供することを可能にすることを目的としている。

【解決手段】 中空糸膜モジュールケース4と可撓性樹脂容器12との間にエア駆動弁10を設ける。エア駆動弁10は回転ラック1の回転軸2に設けたエア配管13を通じて回転ラック1の外部から圧縮空気を供給することで作動して注入チューブ9を開閉可能に構成したことを特徴とする。



【特許請求の範囲】

【請求項1】 多数の中空糸膜端部を接着剤で固定し、該中空糸膜端部の接着部の内側を可撓性樹脂層で覆って接着界面の中空糸膜を補強した中空糸膜モジュールを製造する中空糸膜モジュールの2層遠心接着装置において、

中空糸膜を収容すると共に回転体に固定されて回転可能な中空糸膜モジュールケースと可撓性樹脂を収容する可撓性樹脂容器とを接続する配管の間に該配管の流路を開閉可能な弁手段を設けたことを特徴とする中空糸膜モジュールの2層遠心接着装置。

【請求項2】 前記弁手段は、前記回転体の回転軸に設けたエア配管を通じて該回転体の外部から圧縮空気を供給することにより前記中空糸膜モジュールケースと前記可撓性樹脂容器とを接続する配管の流路を開閉可能なエア駆動弁で構成したことを特徴とする請求項1に記載の中空糸膜モジュールの2層遠心接着装置。

【請求項3】 前記弁手段は、前記回転体の回転軸に設けたエア配管を通じて該回転体の外部から圧縮空気を供給することにより前記中空糸膜モジュールケースと前記可撓性樹脂容器とを接続する配管の流路を開閉可能なエア駆動シリンダー弁で構成したことを特徴とする請求項1に記載の中空糸膜モジュールの2層遠心接着装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、中空糸膜モジュールに遠心力を作用させて中空糸膜端部を接着剤で封止する中空糸膜モジュールの遠心接着装置に係り、詳しくは、接着界面の中空糸膜を可撓性樹脂で補強する2層遠心接着により中空糸膜モジュールを製造する中空糸膜モジュールの2層遠心接着装置に関するものである。

【0002】

【従来の技術】中空糸膜モジュールは単位容積当たりの膜面積が大きくとれることから、逆浸透膜、限外透過膜、精密透過膜等に一般的に用いられている。中空糸膜モジュールの組み立て方法としては、まず、中空糸膜束をケースに挿入し、次いで中空糸膜束の端部を目止めして、次いで該ケースを回転させて、その両端部に遠心力を作用させた状態で接着剤を中空糸膜束間及び該中空糸膜束とケースとの間に流し込み、中空糸膜束及びケースの端部を接着固定してから該中空糸膜束の端部を切断、開口し、中空糸膜モジュールが製造される。

【0003】中空糸膜束及びケースの端部を接着固定するための接着剤としてエポキシ樹脂またはウレタン樹脂が一般に用いられているが、これ等の接着剤は粘度が高いために、上記中空糸膜モジュールの製造段階で、接着剤は、まず、ケースと中空糸膜束との間の比較的大きな隙間を通して侵入し、次いで中空糸膜束間の比較的小さな隙間を通して侵入する。

【0004】このため、中空糸膜と接着剤との接着界面には、接着剤が薄くコーティングされただけの状態では硬化する場合がある。このような部位は、中空糸膜モジュールの原液や透過液の出入口となるノズルに近い場合、使用条件が厳しいと上記接着界面で中空糸膜が折れてしまう虞があった。

【0005】特に、原子力発電所の復水処理や上水の除濁処理では、中空糸膜に付着した固形分を空気によって該中空糸膜を振動させて振るい落とす空気スクラビング方式が採用されているため、接着界面の中空糸膜の補強が重要となっている。

【0006】このため、実開昭61-132002号公報、特開昭61-157308号公報及び特開昭62-144708号公報に開示されたように、上記接着界面の部分を可撓性樹脂で補強する2層遠心接着の技術が提案されている。これ等、2層遠心接着技術の従来例としては、接着剤が硬化してから遠心接着装置を停止させた後、可撓性樹脂をセットして再度遠心接着により注入していた。

【0007】

【発明が解決しようとする課題】しかしながら、中空糸膜モジュールの製造においては、接着剤の硬化速度を速くすると、接着剤の硬化発熱温度が高くなり、接着部の割れやケースとの剥離が発生するため、接着剤の硬化速度を極力遅くする必要があり、このため、長時間の硬化時間を必要としていた。

【0008】また、可撓性樹脂は接着界面の補強のみに使用されるために樹脂量が少なく、樹脂温度を高くしても周囲に熱を奪われるため硬化時間が長くなり、2層遠心接着を採用した場合には、全体の接着時間が、可撓性樹脂による補強を行わない場合の2倍以上の時間を要するという問題があった。

【0009】本発明は前記課題を解決するものであり、その目的とするところは、接着剤と可撓性樹脂とにより2層遠心接着する際に遠心接着装置の回転体の回転を停止することなく接着工程を実施することにより接着時間の短縮を図ると共に、可撓性樹脂が中空糸膜束間の奥まで入り込むようにして接着界面の保護効果を高めることが出来る中空糸膜モジュールの2層遠心接着装置を提供せんとするものである。

【0010】

【課題を解決するための手段】本発明者等は、上記課題を解決するために鋭意検討した結果、遠心接着により接着剤の注入が完了した後、遠心接着装置の回転体の回転を停止しないで、該回転体の回転軸に設けたエア配管を通じて該回転体の外部から圧縮空気を導入し、この圧縮空気によって可撓性樹脂の流路を開閉する弁手段を作動させて可撓性樹脂を注入すれば、接着剤の硬化と可撓性樹脂の硬化とが略同時に出来、しかも、可撓性樹脂が中空糸膜束間の奥まで染み込み、接着界面の保護効果も大きいことを見出し、本発明を完成させたものである。

る。

【0011】即ち、前記目的を達成するための本発明に係る代表的な構成は、多数の中空糸膜端部を接着剤で固定し、該中空糸膜端部の接着部の内側を可撓性樹脂層で覆って接着界面の中空糸膜を補強した中空糸膜モジュールを製造する中空糸膜モジュールの2層遠心接着装置において、中空糸膜を収容すると共に回転体に固定されて回転可能な中空糸膜モジュールケースと可撓性樹脂を収容する可撓性樹脂容器とを接続する配管の間に前記回転体の回転軸に設けたエア配管を通じて該回転体の外部から圧縮空気を供給することにより前記中空糸膜モジュールケースと前記可撓性樹脂容器とを接続する配管の流路を開閉可能なエア駆動弁を設けたことを特徴とする中空糸膜モジュールの2層遠心接着装置である。

【0012】上記構成において使用される接着剤とは、エポキシ樹脂、ウレタン樹脂等の中で中空糸膜の固定に一般的に使用されているような耐圧強度の高いものであり、また、可撓性樹脂とは、前記接着剤よりも軟らかい材質であることが必要であり、例えば、ウレタン樹脂、シリコン樹脂等のように可撓性を持つものであれば良い。好ましくは、用いられる中空糸膜よりも弾性率の小さい樹脂である。

【0013】更に、接着剤と可撓性樹脂との組み合わせとして、接着剤のほうが比重が小さい場合には、接着剤層が遠心力の作用する内側、即ち、中空糸膜モジュールの接着界面側に形成され、中空糸膜の保護にならないため、接着剤のほうが比重が大きくなるように選択する必要がある。更に、接着剤は中空糸膜と強固に接着力を有するものが選ばれるが、可撓性樹脂は中空糸膜と接着力があってもなくても良い。

【0014】また、上記構成において、中空糸膜の材質は、ポリスルホン系樹脂、ポリアクリロニトリル系樹脂、フッ素系樹脂、ポリオレフィン樹脂、セルロース系樹脂等が適用可能であり、特に限定されないが、ポリスルホン系樹脂、アクリロニトリル系樹脂、セルロース系樹脂のように、引張強度、伸度の小さい中空糸膜を用いた場合に特に効果的である。

【0015】また、弁手段としては、中空糸膜モジュールケースと可撓性樹脂容器とを接続する配管の間にボール弁、バタフライ弁等のエア駆動弁を設け、該エア駆動弁を閉鎖した状態で回転体の回転を開始し、所定時間後、該エア駆動弁を開放して可撓性樹脂を注入すれば良い。

【0016】このエア駆動弁は、遠心接着装置の回転体の回転軸に設けたエア配管から圧縮空気を供給することにより可撓性樹脂の流路を連通または遮断させるように構成すれば好ましい。

【0017】更に好ましくは、前記エア駆動弁の代わりに、エア駆動シリンダー弁を用いて可撓性樹脂を導入するための配管となる弾性を有するチューブを外部か

ら押さえつけて或いは押さえつけを解除して可撓性樹脂の流路を遮断または連通するように構成すれば、該チューブ内で硬化した可撓性樹脂をチューブ毎交換すれば良く、作業性が向上する。

【0018】本発明の中空糸膜モジュールの2層遠心接着装置は、接着剤と可撓性樹脂の硬化時間を一定にするために、遠心接着装置内を温調できることが好ましい。

【0019】

【発明の実施の形態】図により本発明に係る中空糸膜モジュールの2層遠心接着装置の一実施形態を具体的に説明する。図1は本発明に係る中空糸膜モジュールの2層遠心接着装置の構成を示す模式図、図2は中空糸膜束の端部が接着剤と可撓性樹脂とにより2層で接着された様子を示す部分拡大図、図3はエア駆動シリンダー弁の構成を示す図である。

【0020】本発明に係る中空糸膜モジュールの2層遠心接着装置Aは、図1に示すように、回転軸2を中心に回転する回転体となる回転ラック1と、回転軸2を介して回転ラック1を回転させるモータ等の回転手段3を有する。回転ラック1には、中空糸膜モジュールケース4が固定され、該中空糸膜モジュールケース4の両端には接着治具7が押さえ治具6により固定される。

【0021】接着治具7には、エポキシ樹脂、ウレタン樹脂等の接着剤を収容する接着剤容器11が配管となる注入チューブ8で接続されている。また、中空糸膜モジュールケース4のノズル5には、ウレタン樹脂、シリコン樹脂のように可撓性を持つ可撓性樹脂を収容する可撓性樹脂容器12が弁手段となるボール弁やバタフライ弁等で構成されるエア駆動弁10を介して配管となる注入チューブ9で接続されている。

【0022】また、回転ラック1と回転軸2とが整合するようにカバー17にロータリーシール14が設けられており、該ロータリーシール14には回転体である回転ラック1の外部から図示しないコンプレッサにより生成された圧縮空気がエア配管16を流通して操作レバー15を介して供給され、更にロータリーシール14からエア配管13を通じてエア駆動弁10に供給されるようになっている。

【0023】これにより、操作レバー15を操作することで、回転ラック1の回転軸2に設けたエア配管13を通じて回転ラック1の外部から圧縮空気を供給することにより回転ラック1の回転を止めることなくエア駆動弁10の開閉を行うことが出来、該エア駆動弁10を介して注入チューブ9の流路の開閉を行うことが出来るようになっている。

【0024】上記構成の中空糸膜モジュールの2層遠心接着装置Aにより製造される中空糸膜モジュールの具体例について図1及び図2を用いて説明する。まず、分画分子量13000、糸外径1.35mmのポリアクリロニトリル製の中空糸膜18を2350本束にして、その端部

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を目止めし、内径が3インチ(約83mm)のPVC製の中空糸膜モジュールケース4に充填して該中空糸膜モジュールケース4の端部に押さえ治具6により接着治具7を固定する。

【0025】接着治具7には接着剤容器11を注入チューブ8で接続し、中空糸膜モジュールケース4のノズル5にはエア駆動弁10を介して可撓性樹脂容器12を注入チューブ9で接続する。

【0026】接着剤容器11には接着剤となる2液型のエポキシ樹脂11aを夫々260グラム充填し、可撓性樹脂容器12には可撓性樹脂となる2液型のシリコン樹脂12aを夫々55グラム充填し、エア駆動弁10を閉鎖した状態で遠心接着を開始する。この時、遠心接着装置A内を35℃に保温して、回転ラック1を300rpmで回転して遠心接着を実施した。この時、接着剤容器11から接着剤となるエポキシ樹脂11aが注入される。

【0027】そして、回転ラック1の回転を開始して5分後にエア駆動弁10を開放して可撓性樹脂容器12から可撓性樹脂となるシリコン樹脂12aを注入した。そして、回転ラック1の回転開始時点から7時間後に該回転ラック1の回転を停止させて遠心接着装置Aから中空糸膜モジュールを取り出したところ、エポキシ樹脂11aもシリコン樹脂12aも流動しない程度に硬化していた。

【0028】ここで、接着剤と可撓性樹脂の注入量と注入開始時間は、製作する中空糸膜モジュールの大きさ、中空糸膜束の充填率、チューブ径、接着剤の注入速度、接着剤の種類、可撓性樹脂の種類等によって夫々所定の条件が設定される。

【0029】また、上述のようにして製造された中空糸膜モジュールを長手方向に切断して接着部分の断面を観察したところ、エポキシ樹脂11a、シリコン樹脂12aが中空糸膜18束内部まで2層に分かれ、且つ、中空糸膜18の長手方向に対して略垂直の界面を形成して硬化していることが確認された。

【0030】次に本発明に係る中空糸膜モジュールの2層遠心接着装置の他の構成として、前記エア駆動弁10の代わりに、図3に示すようなエア駆動シリンダー弁21を使用することも出来る。エア駆動シリンダー弁21はエア配管13を介して供給された圧縮空気により押圧部材22が上下動して弾性を有する注入チューブ9を外部から押さえつけて、或いは押さえつけを解除して該注入チューブ9を閉鎖或いは開放するようになっている。

【0031】前述のボール弁やバタフライ弁等のエア駆動弁10を使用した場合、該エア駆動弁10の内部で硬化したシリコン樹脂12aを取り除くためにはエア駆

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動弁10本体の分解等の作業が必要になるが、エア駆動シリンダー弁21を使用した場合には、注入チューブ9の内部で硬化したシリコン樹脂12aを該注入チューブ9毎取り外して交換すれば良く、作業性が良い。

【0032】

【発明の効果】本発明は、上述の如き構成と作用とを有するので、接着剤と可撓性樹脂を2層遠心接着する際に、遠心接着装置の回転体の回転を停止させることなく接着工程を実施することで、接着時間を大幅に短縮できる。

【0033】また、可撓性樹脂が中空糸膜束間の奥まで入り込むので接着界面の保護効果を高めることが出来る。

【図面の簡単な説明】

【図1】本発明に係る中空糸膜モジュールの2層遠心接着装置の構成を示す模式図である。

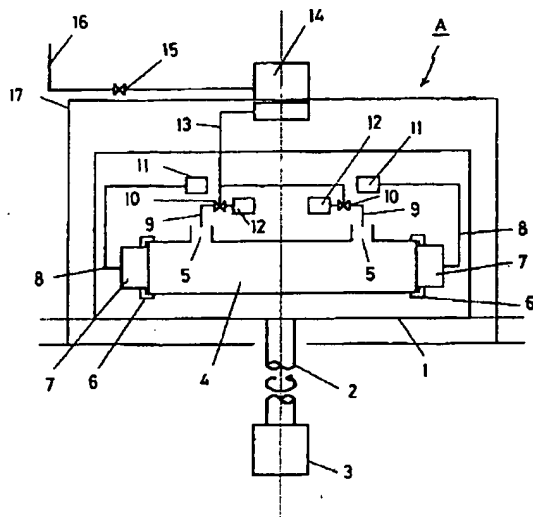
【図2】中空糸膜束の端部が接着剤と可撓性樹脂とにより2層で接着された様子を示す部分拡大図である。

【図3】エア駆動シリンダー弁の構成を示す図である。

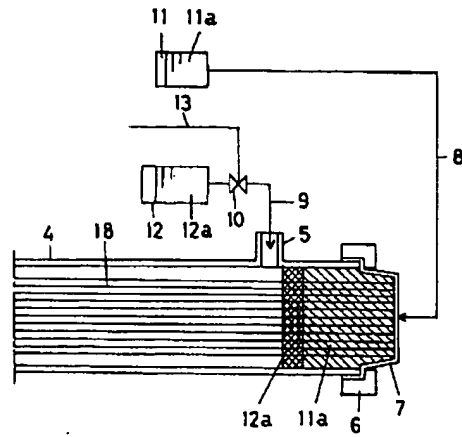
【符号の説明】

- 1…回転ラック
- 2…回転軸
- 3…回転手段
- 4…中空糸膜モジュールケース
- 5…ノズル
- 6…押さえ治具
- 7…接着治具
- 8、9…注入チューブ
- 10…エア駆動弁
- 11…接着剤容器
- 11a…エポキシ樹脂
- 12…可撓性樹脂容器
- 12a…シリコン樹脂
- 13…エア配管
- 14…ロータリーシール
- 15…操作レバー
- 16…エア配管
- 17…カバー
- 18…中空糸膜
- 21…エア駆動シリンダー弁
- 22…押圧部材
- A…遠心接着装置

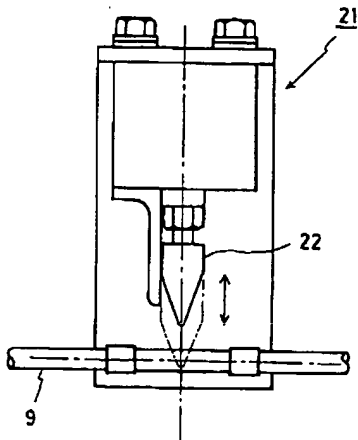
【図1】



【図2】



【図3】



PAT-NO: JP411033366A

DOCUMENT-IDENTIFIER: JP 11033366 A

TITLE: TWO-LAYER CENTRIFUGAL BONDING DEVICE OF HOLLOW FIBER MEMBRANE MODULE

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ABSTRACT:

PROBLEM TO BE SOLVED: To shorten bonding time by providing a pneumatically operated valve capable of opening and closing a passage in a midway of a connection pipe between a hollow fiber membrane module case having hollow fiber membranes included therein and rotatably fixed on a rotative body and a container having a flexible resin contained therein.

SOLUTION: A particular number of hollow fiber membranes are bundled and their end parts are stopped and are filled in a hollow fiber membrane module case 4 and a bonding jig 7 is fixed to an end part of the case 4 by means of a jig 6. The bonding jig 7 is connected to an adhesive container 11 with an injection tube 8 and a nozzle 5 of the hollow fiber membrane module case 4 is connected to a flexible resin container 12 via a pneumatically operated valve 10 with an injection tube 9. The adhesive container 11 and a flexible resin container 12 are filled with an adhesive and a flexible resin, respectively, and the pneumatically operated valve 10 is closed and centrifugal bonding is started. The adhesive is injected from the adhesive container 11 and a rotatable rack 1 is rotated for a specified period of time before the

pneumatically operated valve 10 is fully opened and the resin is injected from the flexible resin container 12 and rotation of the rack 1 is stopped after an elapse of a specified period of time. Bonding is carried out without stopping rotation of a rotative body of a centrifugal bonding device so that bonding time is largely shortened.

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TITLE: Bi-layer centrifugal adhesive bonding apparatus for hollow fibre membrane module - has valve to open and close piping that connects hollow fibre membrane case to flexible resin receptacle

----- KWIC -----

Basic Abstract Text - ABTX (1):

NOVELTY - A piping (13) is provided between a case (4) accommodating hollow fiber membrane module and a flexible resin receptacle (12) storing flexible resin. A valve (10) opens and closes the flow path of the piping. The receptacle is arranged in a rotation rack (1) rotatable above a shaft (2). A flexible resin layer is coated to inner edge of the hollow fiber membrane module through the adhesive agent.

Basic Abstract Text - ABTX (2):

USE - For hollow fiber membrane module used as reverse osmosis membrane, ultrafiltration membrane and precise filter.

Title - TIX (1):

Bi-layer centrifugal adhesive bonding apparatus for hollow fibre membrane module - has valve to open and close piping that connects hollow fibre membrane case to flexible resin receptacle

Standard Title Terms - TTX (1):

BI LAYER CENTRIFUGE ADHESIVE BOND APPARATUS HOLLOW FIBRE MEMBRANE MODULE
VALVE OPEN CLOSE PIPE CONNECT HOLLOW FIBRE MEMBRANE CASE FLEXIBLE
RESIN
RECEPTACLE

PATENT ABSTRACTS OF JAPAN

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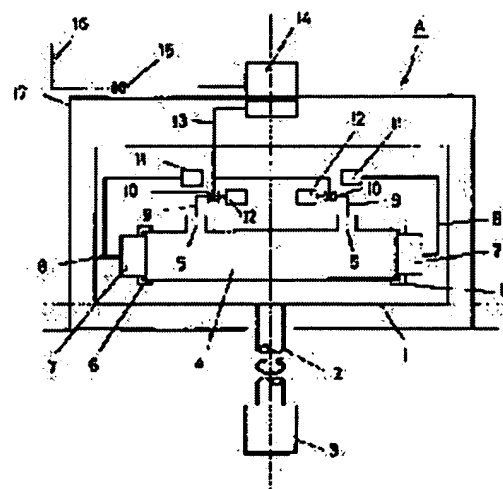
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(54) TWO-LAYER CENTRIFUGAL BONDING DEVICE OF HOLLOW FIBER MEMBRANE MODULE

(57)Abstract:

PROBLEM TO BE SOLVED: To shorten bonding time by providing a pneumatically operated valve capable of opening and closing a passage in a midway of a connection pipe between a hollow fiber membrane module case having hollow fiber membranes included therein and rotatably fixed on a rotative body and a container having a flexible resin contained therein.

SOLUTION: A particular number of hollow fiber membranes are bundled and their end parts are stopped and are filled in a hollow fiber membrane module case 4 and a bonding jig 7 is fixed to an end part of the case 4 by means of a jig 6. The bonding jig 7 is connected to an adhesive container 11 with an injection tube 8 and a nozzle 5 of the hollow fiber membrane module case 4 is connected to a flexible resin container 12 via a pneumatically operated valve 10 with an injection tube 9. The adhesive container 11 and a flexible resin container 12 are filled with an adhesive and a flexible resin, respectively, and the pneumatically operated valve 10 is closed and centrifugal bonding is started. The adhesive is injected from the adhesive container 11 and a rotatable rack 1 is rotated for a specified period of time before the pneumatically operated valve 10 is fully opened and the resin is injected from the flexible resin container 12 and rotation of the rack 1 is stopped after an elapse of a specified period of time. Bonding is carried out without stopping rotation of a rotative body of a centrifugal bonding device so that bonding time is largely shortened.



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CLAIMS

[Claim(s)]

[Claim 1] In the two-layer centrifugal adhesion equipment of the hollow fiber module which manufactures the hollow fiber module which fixed many hollow fiber edges with adhesives, covered the inside of jointing of this hollow fiber edge in the flexible resin layer, and reinforced the hollow fiber of an adhesion interface Two-layer centrifugal adhesion equipment of the hollow fiber module characterized by establishing the valve means which can open and close the passage of this piping between piping which connects the flexible resin container which is fixed to body of revolution and holds a pivotable hollow fiber module case and flexible resin while holding a hollow fiber.

[Claim 2] Said valve means is two-layer centrifugal adhesion equipment of the hollow fiber module according to claim 1 characterized by constituting from an Ayr actuation valve which can open and close the passage of piping which connects said hollow fiber module case and said flexible resin container by supplying a compressed air from the exterior of this body of revolution through Ayr piping prepared in the revolving shaft of said body of revolution .

[Claim 3] Said valve means is two-layer centrifugal adhesion equipment of the hollow fiber module according to claim 1 characterized by constituting from an Ayr driving cylinder valve which can open and close the passage of piping which connects said hollow fiber module case and said flexible resin container by supplying a compressed air from the exterior of this body of revolution through Ayr piping prepared in the revolving shaft of said body of revolution .

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the centrifugal adhesion equipment of the hollow fiber module which a centrifugal force is made to act on a hollow fiber module, and closes a hollow fiber edge with adhesives, and relates to the two-layer centrifugal adhesion equipment of the hollow fiber module which manufactures a hollow fiber module in detail by two-layer centrifugal adhesion which reinforces the hollow fiber of an adhesion interface by flexible resin.

[0002]

[Description of the Prior Art] Since a hollow fiber module can take the large film surface product per unit volume, generally it is used to a reverse osmotic membrane, ultrafiltration membrane, a micro filter, etc. As an approach to assemble a hollow fiber module First, insert a hollow fiber bundle in a case and, subsequently the edge of a hollow fiber bundle is filled. Subsequently, this case is rotated, adhesives are slushed in the condition of having made the centrifugal force acting on the both ends, between hollow fiber bundles and between this hollow fiber bundle and a case, after carrying out adhesion immobilization of the edge of a hollow fiber bundle and a case, it cuts and opening of the edge of this hollow fiber bundle is carried out, and a hollow fiber module is manufactured.

[0003] Although an epoxy resin or urethane resin is generally used as adhesives for carrying out adhesion immobilization of the edge of a hollow fiber bundle and a case, since adhesives, such as this, have high viscosity, in the manufacture phase of the above-mentioned hollow fiber module, first, adhesives invade through the comparatively big clearance between a case and a hollow fiber bundle, and, subsequently invade through the comparatively small clearance between hollow fiber bundles.

[0004] For this reason, to the adhesion interface of a hollow fiber and adhesives, adhesives may harden only in the condition by which coating was carried out thinly. Since such a part was close to the nozzle used as the gate of the undiluted solution of a hollow fiber module, or filtrate, when the service condition was severe, it had a possibility that a hollow fiber might break with the above-mentioned adhesion interface.

[0005] Since the air scrubbing method which this hollow fiber is vibrated and eliminates the solid content adhering to a hollow fiber with air is especially adopted by condensation-processing of a nuclear power plant, or turbidity reduction processing of a waterworks, reinforcement of the hollow fiber of an adhesion interface is important.

[0006] For this reason, as indicated by JP,61-132002,U, JP,61-157308,A, and JP,62-144708,A, the technique of two-layer centrifugal adhesion of reinforcing the part of the above-mentioned adhesion interface by flexible resin is proposed. After adhesives hardened this etc. as a conventional example of a two-layer centrifugal adhesion technique and stopping centrifugal adhesion equipment, flexible resin was set and it was pouring in by centrifugal adhesion again.

[0007]

[Problem(s) to be Solved by the Invention] However, in manufacture of a hollow fiber module, if the cure rate of adhesives was made quick, since the hardening exoergic temperature of adhesives would become high and the crack of jointing and exfoliation with a case would occur, the cure rate of adhesives needed to be made late as much as possible, and, for this reason, the setting time of long duration was needed.

[0008] Moreover, flexible resin had the problem of requiring twice [in case the whole adhesion time amount does not perform reinforcement by flexible resin / more than] as many time amount as this, when the setting time started for a long time and adopted two-layer centrifugal adhesion, since heat was around taken even if

there are few amounts of resin and they make resin temperature high, since it is used only for reinforcement of an adhesion interface.

[0009] This invention solves said technical problem, and the place which makes into the object uses as an offer plug the two-layer centrifugal adhesion equipment of the hollow-fiber module with which it can heighten the protective effect of an adhesion interface as flexible resin enters to the back between hollow-fiber bundles while aiming at compaction of adhesion time amount by carrying out an adhesion process, without suspending the revolution of the body of revolution of centrifugal adhesion equipment in case two-layer centrifugal adhesion is carried out with adhesives and flexible resin.

[0010]

[Means for Solving the Problem] Without suspending the revolution of the body of revolution of centrifugal adhesion equipment, after impregnation of adhesives is completed by centrifugal adhesion, as a result of inquiring wholeheartedly, in order that this invention person etc. may solve the above-mentioned technical problem If the compressed air is introduced from the exterior of this body of revolution through Ayr piping prepared in the revolving shaft of this body of revolution, a valve means to open and close the passage of flexible resin by this compressed air is operated and flexible resin is poured in Hardening of adhesives and hardening of flexible resin are made to abbreviation coincidence, moreover, flexible resin sinks in to the back between hollow fiber bundles, it finds out that the protective effect of an adhesion interface is also large, and this invention is completed.

[0011] Namely, the typical configuration concerning this invention for attaining said object In the two-layer centrifugal adhesion equipment of the hollow fiber module which manufactures the hollow fiber module which fixed many hollow fiber edges with adhesives, covered the inside of jointing of this hollow fiber edge in the flexible resin layer, and reinforced the hollow fiber of an adhesion interface Between piping which connects the flexible resin container which is fixed to body of revolution and holds a pivotable hollow fiber module case and flexible resin while holding a hollow fiber By supplying the compressed air from the exterior of this body of revolution through Ayr piping prepared in the revolving shaft of said body of revolution It is two-layer centrifugal adhesion equipment of the hollow fiber module characterized by preparing the Ayr actuation valve which can open and close the passage of piping which connects said hollow fiber module case and said flexible resin container.

[0012] What is necessary is just to have flexibility like urethane resin and silicone resin for pressure resistance of the adhesives used in the above-mentioned configuration which is generally used to immobilization of a hollow fiber in an epoxy resin, urethane resin, etc. to be high, and required [to be construction material with flexible resin softer than said adhesives]. It is resin with an elastic modulus preferably smaller than the hollow fiber used.

[0013] Furthermore, since an adhesives layer is formed in an inside [on which a centrifugal force acts], i.e., adhesion interface of hollow fiber module, side and does not become protection of a hollow fiber as a combination of adhesives and flexible resin when the way of adhesives has small specific gravity, the way of adhesives needs to choose so that specific gravity may become large. Furthermore, although that in which adhesives have adhesive strength firmly with a hollow fiber is chosen, flexible resin may have a hollow fiber and adhesive strength, or there may be. [no]

[0014] Moreover, in the above-mentioned configuration, although polysulfone system resin, polyacrylonitrile system resin, fluororesin, polyolefin resin, cellulose type resin, etc. can be applied and it is not limited especially, especially when a hollow fiber with small tensile strength and ductility is used, it is effective [the construction material of a hollow fiber] like polysulfone system resin, acrylonitrile system resin, and cellulose type resin.

[0015] Moreover, what is necessary is to prepare the Ayr actuation valves, such as a ball valve and a butterfly valve, as a valve means between piping which connects a hollow fiber module case and a flexible resin container, to start the revolution of body of revolution, where this Ayr actuation valve is closed, to open this Ayr actuation valve and just to pour in flexible resin after predetermined time.

[0016] If this Ayr actuation valve is constituted so that the passage of flexible resin may be made to open for free passage or intercept by supplying the compressed air from Ayr piping prepared in the revolving shaft of the body of revolution of centrifugal adhesion equipment, it is desirable.

[0017] Furthermore, if it constitutes so that the tube which has the elasticity used as piping for using the Ayr actuation cylinder valve and introducing flexible resin instead of said Ayr actuation valve preferably may be pressed down from the outside, or pressing down may be canceled and the passage of flexible resin may be

intercepted or opened for free passage, workability will improve that what is necessary is just to exchange the flexible resin hardened within this tube the whole tube.

[0018] In order to make the setting time of adhesives and flexible resin regularity, as for the two-layer centrifugal adhesion equipment of the hollow fiber module of this invention, it is desirable that the temperature control of the inside of centrifugal adhesion equipment can be carried out.

[0019]

[Embodiment of the Invention] One operation gestalt of the two-layer centrifugal adhesion equipment of the hollow fiber module applied to this invention with drawing is explained concretely. The mimetic diagram showing the configuration of the two-layer centrifugal adhesion equipment of the hollow fiber module which drawing 1 requires for this invention, the elements on larger scale showing signs that the edge of a hollow fiber bundle pasted up drawing 2 by two-layer with adhesives and flexible resin, and drawing 3 are drawings showing the configuration of the Ayr driving cylinder valve.

[0020] The two-layer centrifugal adhesion equipment A of the hollow fiber module concerning this invention has the revolution means 3, such as the carousel 1 used as the body of revolution rotated centering on a revolving shaft 2, and a motor made to rotate a carousel 1 through a revolving shaft 2, as shown in drawing 1. The hollow fiber module case 4 is fixed to a carousel 1, and the adhesion fixture 7 is fixed to the ends of this hollow fiber module case 4 with the presser-foot fixture 6.

[0021] The adhesives container 11 which holds adhesives, such as an epoxy resin and urethane resin, is connected to the adhesion fixture 7 by the impregnation tube 8 used as piping. Moreover, it connects with the nozzle 5 of the hollow fiber module case 4 by the impregnation tube 9 by which the flexible resin container 12 which holds urethane resin and the flexible resin which has flexibility like silicone resin serves as piping through the Ayr actuation valve 10 which consists of a ball valve used as a valve means, a butterfly valve, etc.

[0022] Moreover, the rotary seal 14 is formed in covering 17 so that a carousel 1 and a revolving shaft 2 may have consistency, and the compressed air generated by this rotary seal 14 by the compressor which is not illustrated from the outside of the carousel 1 which is body of revolution circulates the Ayr piping 16, is supplied through a control lever 15, and is further supplied to the Ayr actuation valve 10 through the Ayr piping 13 from a rotary seal 14.

[0023] Thereby, the Ayr actuation valve 10 can be opened and closed, without stopping a revolution of a carousel 1 by supplying the compressed air from the exterior of a carousel 1 through the Ayr piping 13 prepared in the revolving shaft 2 of a carousel 1, and passage of the impregnation tube 9 can be opened now by operating a control lever 15 and closed through this Ayr actuation valve 10.

[0024] The example of the hollow fiber module manufactured by the two-layer centrifugal adhesion equipment A of the hollow fiber module of the above-mentioned configuration is explained using drawing 1 and drawing 2. First, the hollow fiber 18 with a cut off molecular weight [13000] and a yarn outer diameter of 1.35mm made from the poly acrylic nitril is made into 2350 bundles, the edge is filled, and a bore is 3 inches (about 83mm). The hollow fiber module case 4 made from PVC is filled up, and the adhesion fixture 7 is fixed to the edge of this hollow fiber module case 4 with the presser-foot fixture 6.

[0025] The adhesives container 11 is connected to the adhesion fixture 7 by the impregnation tube 8, and the flexible resin container 12 is connected to the nozzle 5 of the hollow fiber module case 4 by the impregnation tube 9 through the Ayr actuation valve 10.

[0026] The adhesives container 11 is filled up with 260g 2 liquid type epoxy resin 11a used as adhesives, respectively, the flexible resin container 12 is filled up with 55g 2 liquid type silicone resin 12a used as flexible resin, respectively, and centrifugal adhesion is started where the Ayr actuation valve 10 is closed. At this time, the inside of centrifugal adhesion equipment A was kept warm at 35 degrees C, the carousel 1 was rotated by 300rpm, and centrifugal adhesion was carried out. At this time, epoxy resin 11a which becomes adhesives from the adhesives container 11 is poured in.

[0027] And 5 minutes after starting a revolution of a carousel 1, silicone resin 12a which opens the Ayr actuation valve 10 and becomes flexible resin from the flexible resin container 12 was poured in. And when the revolution of this carousel 1 was stopped and the hollow fiber module was picked out from centrifugal adhesion equipment A 7 hours after the revolution initiation event of a carousel 1, it had hardened to extent to which epoxy resin 11a or silicone resin 12a does not flow, either.

[0028] Here, predetermined conditions are set up, respectively according to the magnitude of the hollow fiber module which manufactures the injection rate and impregnation start time of adhesives and flexible resin, the filling factor of a hollow fiber bundle, the diameter of a tube, the grouting velocity of adhesives, the class of

adhesives, the class of flexible resin, etc.

[0029] Moreover, when the hollow fiber module manufactured as mentioned above was cut to the longitudinal direction and the cross section for jointing was observed, epoxy resin 11a and silicone resin 12a were divided into two-layer to the interior of 18 bundles of hollow fibers, and having formed and hardened the interface of an abbreviation perpendicular to the longitudinal direction of a hollow fiber 18 was checked.

[0030] Next, as other configurations of the two-layer centrifugal adhesion equipment of the hollow fiber module concerning this invention, the Ayr driving cylinder valve 21 as shown in drawing 3 can also be used instead of said Ayr actuation valve 10. The Ayr actuation cylinder valve 21 presses down from the outside the impregnation tube 9 which the press member 22 moves up and down by the compressed air supplied through the Ayr piping 13, and has elasticity, or cancels pressing down, and closes or opens this impregnation tube 9.

[0031] When the Ayr actuation valves 10, such as the above-mentioned ball valve and a butterfly valve, are used, in order to remove silicone resin 12a hardened inside this Ayr actuation valve 10, the activity of disassembly of Ayr actuation valve 10 body etc. is needed, but workability is [that what is necessary is to picking-remove silicone resin 12a hardened inside the impregnation tube 9 this whole impregnation tube 9, and just to exchange it] good when the Ayr actuation cylinder valve 21 is used.

[0032]

[Effect of the Invention] Since this invention has the configuration and operation like ****, in case it carries out two-layer centrifugal adhesion of adhesives and the flexible resin, it is carrying out an adhesion process, without stopping the revolution of the body of revolution of centrifugal adhesion equipment, and can shorten adhesion time amount substantially.

[0033] Moreover, since flexible resin enters to the back between hollow fiber bundles, the protective effect of an adhesion interface can be heightened.

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